PARASITIC IMPACT ON ELEPHANT CONSERVATION: A KENYAN VIEW

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Hany Elsheikha, Vincent Obanda discuss the risk of parasitic infections in the African elephant in their diverse forms, the environmental conditions that help drive them and influence mortality, and future directions

THE African elephant (*Loxodonta africana*) and the Asian elephant (*Elephas maximus*) have been the two species indigenous to their respective continents.

However, genetic studies suggest the African forest elephant, *Loxodonta africana cyclotis,* is a distinct species from the African savannah elephant, *Loxodonta africana africana,* which suggests two extant species. In Kenya, only savannah elephants ([Figure 1]) occupy the mosaic savannah landscape, including the mountain and coastal forests.

Poaching, climate change, habitat fragmentation and loss are some of the most significant challenges facing African elephant conservation ([Figure 2]). Poaching nearly decimated Kenya's elephant population, but due to intensive security and monitoring, it is recovering: a recent estimate of 35,000 elephants is an increase from the last recorded count of 23,353 in 2006.

A high demand for already scarce resources, such as land and water, tend to drive human/ elephant conflicts, which further reduce demographics at local scales. As a result, translocation has been used to alleviate both conflicts and pressure on degraded habitat fragments in Kenya and Uganda. Although this is a useful population management strategy, it bears the risk of spreading disease.

Despite being traditionally neglected in wildlife, parasitism is now considered important in conservation, which is perhaps due to its high threats to endangered species.

Parasitic infection risk

Elephants are considered a flagship species, whose continued existence will sustain both ecological integrity and biodiversity in the habitat in which they live. For this reason, parasite and disease management strategies in free-ranging elephants could benefit conservation of biodiversity as a whole. It is interesting that although elephant populations are often large and widely distributed across the African continent, their parasite epidemiology is scantly studied – most research is taxonomic. Few studies have described the effects of parasitic infections on free-ranging elephants.

When parasites – known to have the potential of causing a catastrophic decline in wild animals – were not inclusively detailed in the 2002 International Union for Conservation of Nature (IUCN) red list, it suggested parasitic infections were still not explicitly considered as a formidable cause of host-species extinction. This was in spite of increased reports of parasitic disease outbreaks in wild populations, and their suggested risk to even large populations.

A lack of clinical signs in freeranging hosts, despite heavy parasite burdens reported from necropsies, may have contributed to the neglect of parasitic infections in wildlife. It is hypothesised that both parasites and their hosts have co-evolved, and thereby parasitic infections, particularly helminths, are maintained at a subclinical level. Nevertheless, when parasite-host equilibrium is unbalanced, disease may become apparent and call for veterinary attention, especially in endangered animal species.

The factors that may destabilise parasite-host equilibrium are diverse and include – among others – concurrent infections, pregnancy and lactation as well as changes in climatic conditions. In addition to these factors, elephants occupy extensive home ranges, and are regarded as bulk feeders – consuming both browse and grass, a trait that is likely to influence the transmission of various parasite species.

Diversity and ecology of elephant parasites

Asian and African elephants are generally infected by diverse species of parasitic helminths (worms). Helminths recorded in African elephants include trematodes, cestodes and a high number of nematodes.

Trematodes, such as *Fasciola hepatica* and the elephant specific species *Fasciola jacksoni,* require amphibious snails as intermediate hosts to complete their life history. This implies the definitive host must be in contact with stagnant water to become infected. Free-ranging Asian elephants have been found to have 33.7 per cent prevalence of *F jacksoni.*

The fasciolid species *Protofasciola robusta* (Figure 3), which is at the bottom of the phylogenetic tree of Fasciolidae and the only species of the subfamily Protofasciolinae that infects the intestine of the African elephant, is widespread across savannah elephants and forest elephants in Africa. Its life cycle remains to be described, but is predicted to involve snails as intermediate hosts. The schistosome *Bivitellobilharzia* is a rare species, but has been recorded in African forest elephants.

Elephant tapeworms are scarcely reported – especially in free-ranging elephants, although *Anoplocephala* has been found in a captive Asian elephant. It is suggested that *Anoplocephala manubriata* infects both African and Asian elephants. Generally, *Anoplocephala* species depend on oribatid mites as intermediate hosts, and definitive hosts become infected as they feed on plants infested with mites.

Nematodes have a direct life cycle: eggs released with faeces develop into infective larvae that crawl into grass tips and become ingested by grazing herbivores. Most of the strongylid nematodes (Nematoda: *Strongylidae*) have a typical egg that is indistinguishable morphologically and generally referred to as strongyles. Nematodes are the highly prevalent and abundant helminths in elephants, probably due to their direct life cycle and demonstrated by the high species richness. The description of a new nematode, *Equinurbia blakei* n species (Nematoda: Strongyloidea: Strongylidae) in the African forest elephant suggests there could be more species yet to be identified.

Helminth eggs and infective larval stages require suitable environmental conditions to ensure transmission. As such, ecological parameters have a fundamental influence on the prevalence, abundance, aggregation and species richness or diversity of parasites.

Elephant parasitism in changing ecology

Parasitic infections are relatively common in captive elephants – causing disease and death. It is likely that the distressful conditions of captivity, which may range from poor nutrition to improper husbandry, may be linked to clinical parasitism in elephants. It can, therefore, be extrapolated that such poor conditions in captivity may be related to conditions in natural habitats that are overgrazed, crowded, polluted with parasite propagules or undergoing drought. Such conditions may be predicted to trigger chronic clinical disease and risk the animals'survival.

As the human population increases in Africa, demand for land escalates – leading to landscape fragmentations and habitat disconnectivity. This has created elephant metapopulations, which are likely to be subject to variable ecological factors and more parasite attacks. The consequences for such an eventuality are bleak, especially to species such as elephants, whose resource demand from the landscape in terms of nutrition and space is vast. When habitat patches become small and isolated they tend to mimic small-fenced reserves, where animals are crowded around resource foci, thereby increasing parasite transmission risk as well as burden in hosts.

During a drought (Figure 4), herbivores, including elephants, undergo hydric and dietary stress, due to the scarcity of water and nutrition. The resultant malnutrition is likely to compromise the immune defence of the host, allowing for parasite build-up within the animal, while the crowding of animals around water holes increases the risk of parasite transmission – all factors that synergistically lead to clinical disease.

It has been predicted that the occurrence of drought is likely to increase, especially in the dry, arid ranges usually occupied by wildlife. This implies the survival and fitness of mammalian mega-herbivores are at risk to the effects of drought, with the probability that latent parasitic infections may become harmful and hasten die-offs.

Elephant mortality associated with drought in Kenya is increasingly frequent – as traced back since the 1973 to 1976 drought, recurring in 1984, 1991 and 1997, with other occurrences not likely published before 2009. In all these past events, detailed postmortems were not done to assess the possible role of parasitism in the deaths. Rather, mortality was generally linked to prevailing drought.

During the 2009 drought, young elephants – especially in the Laikipia/Samburu ecosystem of central Kenya – were severely affected. The elephants were emaciated and had a bony appearance – supposedly due to inadequate pasture. Fresh carcases of some elephants were necropsied, with a heavy presence of parasites (helminths and arthropods) noted. Larval stages of bot fly (Figure 5) occupied most parts of the intestinal tract and were also present in the pharynx. Additionally, *Grammocephalus clathratus* and *P robusta* were identified from the necropsied elephants. The nematode, *G clathratus,* was found in the liver and bile ducts, posing risks of obstructions. The adult flukes, *P robusta,* were densely attached to the inner lining of the intestinal tract, causing pinpoint polyps, likely to interfere with host digestion.

Tissue damage of the inner lining of intestinal mucosa and observed haemorrhage could be related to pathologic lesions observed in sick captive elephants infected with flukes. By the end of the drought, 38 young elephants were dead in the Laikipia/ Samburu ecosystem.

During the drought, the conspicuous loss of vegetation – except a few scattered Acacia species – suggested the animals were starving. Since the canopy of most Acacia trees were beyond the reach of young elephants'trunks, and underground water was too deep, they were likely to be severely distressed. As such, the synergistic effects of starvation, dehydration and heavy gastrointestinal parasites could have hastened the deaths of these sub-adult animals when suckling juveniles and adults were not yet at risk. This scenario points to the possible role of parasites working in synergy – especially in harsh environmental conditions – to not only reduce local demographics, but stagnate overall population growth.

Outlook and future directions

Helminths in African elephants have been documented in past studies conducted in other parts of Africa, while those infecting free-range populations in Kenya remain vague. Increased human/elephant conflicts, habitat degradation and fragmentation that leads to small isolated sub-populations, necessitates active population management. Translocation will necessarily be required to maintain a genetically breeding elephant metapopulation in sustainable habitats.

Therefore, preliminary data on parasites will be vital to guiding pre-translocation plans and for health monitoring. Much research needs to be evaluated concerning elephant parasites – especially helminths. There is a call for more comparative study to assess the effects of seasonal and habitat variation on helminth community in elephants. It is also necessary to identify and characterise elephant helminths by use of molecular techniques, which will be fundamental in determining their spatial distribution.

Long-term studies, especially of populations whose individuals are well known, such as those in Amoboseli National Park, may be useful in revealing the overall impact of worm burden on African elephants.

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